What Works Clearinghouse

INSTITUTE OF EDUCATION SCIENCES

Connected Mathematics Project

Program description

The *Connected Mathematics Project (CMP)* is a problem-centered mathematics curriculum designed for all students in grades 6–8. Each grade level of the curriculum is a full-year program and covers numbers, algebra, geometry/measurement, probability, and statistics. The program seeks to make connections within mathematics, between mathematics and other subject areas, and to the real world. The curriculum is divided into a sequenced set of units, each organized around different mathematical topics. The four to seven lessons in a unit each contain one to five problems that the teacher and students explore in class. Additional problem sets, called Applications, Connections, and Extensions, in each lesson help students practice, apply, connect, and extend their understanding and skills. Each lesson culminates in a Mathematical Reflections activity. According to the developers, the *CMP* addresses National Council of Teachers of Mathematics standards.

Research

Three studies of the *CMP* met the What Works Clearinghouse (WWC) evidence standards with reservations.[1] The three studies included over 26,000 students from grades 6–8 in about 100 schools located in northeastern, south central, midwestern, and western states.

Effectiveness

The *CMP* curriculum was found to have mixed effects on math achievement.

	Math achievement
Rating of effectiveness	Mixed effects
Improvement index[2]	Average: –2 percentile points Range: –12 to +11 percentile points

1. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.
2. These numbers show the average and the range of improvement indices for all findings across two of the three studies. One additional study that showed a statistically significant positive effect is not included in the average and range.

Additional program information

Updating Previous Research

This report updates the previous WWC report on *CMP* that was released on the WWC website in November 2004. Since the release of the previous report, the WWC has updated its evidence standards and developed peer-reviewed procedures for addressing certain methodological flaws in original studies, such as mismatch between the unit of assignment and the unit analysis and lack of adjustment for multiple comparisons. These standards and procedures, when applicable, have been applied to studies included in the original *CMP* review. No new studies were identified for this updated report.

Developer and contact

The *CMP* was developed at Michigan State University by Glenda Lappan, James T. Fey, William F. Fitzgerald, Susan N. Friel, and Elizabeth D. Phillips. Email: cmp@math.msu.edu. Web: http://connectedmath.msu.edu. Telephone: (517) 432-2870. The curriculum is distributed by Pearson Prentice Hall. Web: http://phcatalog.pearson.com.

Scope of use

Pilot editions of *CMP* were used between 1991 and 1997 by approximately 160 teachers and 45,000 students in diverse settings across the United States. As of September 2004, it had been implemented in 2,462 school districts, covering all 50 states.

Teaching

This problem-centered curriculum is based on an inquiry model of instruction, which consists of three phases: launch, explore, and summarize. In the first phase, the teacher launches the problem with the whole class, introduces new ideas, clarifies definitions, reviews old concepts, and connects the problem to students' past experiences. In the explore phase, students work individually, in pairs or small groups, or occasionally as a whole class to solve the problem. In the summarize phase, students discuss their solutions as well as the strategies that they used to approach the problem, organize the data, and find the solution.

Intended as a three-year mathematics curriculum, *CMP* covers grades 6–8, providing eight student units for each grade level. Each student unit is organized around an important mathematical idea or cluster of related ideas and is divided into several investigations, with each investigation containing a series of problems. The implementation plan is based on a 45–60 minute class period and a 180-day school year. The *CMP* provides teacher guides specifically designed for each student unit. The teacher guides include discussions of the mathematics of the unit, instructional strategies, and assessment resources. The developer suggests that when a district uses the curriculum for the first time, it should establish a support system to all the *CMP* teachers in a building.

Cost

According to Pearson Prentice Hall, the publisher, the most recent edition of the *CMP* costs \$8.47 per student and \$20.97 per teacher unit. See the publisher for costs for other resources.

Research

Twenty-two studies reviewed by the WWC investigated the effects of *CMP*. Three studies (Ridgway, Zawojewski, Hoover, & Lambdin, 2002; Riordan & Noyce, 2001;[3] Schneider, 2000) were quasi-experimental designs that met WWC evidence standards with reservations. The remaining 19 studies did not meet WWC evidence screens.

Ridgway, Zawojewski, Hoover, & Lambdin (2002) included students in grades 6–8 from 18 schools located in the midwestern,

3. Riorden & Noyce (2001) also examined effects of the program *Everyday Mathematics*®. For further details of this analysis see the *Everyday Mathematics*® Intervention report.

Research (continued)

western, and eastern regions of the country. Students using the *CMP* curriculum were compared to students who did not use the curriculum.[4]

Riordan & Noyce (2001) included eighth-grade students from 50 schools in Massachusetts. Students using the *CMP* curriculum were compared to students who did not use the *CMP* program, but used different published textbook programs, which, in the aggregate, represented the instructional norm in Massachusetts.

Schneider (2000) included three cohorts of middle school students from 48 schools in Texas. Students using the *CMP* curriculum were compared to students who did not use the curriculum.

Effectiveness

Findings

The WWC review of interventions for middle school math addresses student outcomes in one domain: math achievement.

The Ridgway, Zawojewski, Hoover, & Lambdin (2002) study examined students' scores on the Iowa Test of Basic Skills (ITBS) and reported a statistically significant negative effect, favoring the comparison group; however, the WWC analysis did not confirm the statistical significance of this outcome. The study also examined total scores on the Balanced Assessment Test and reported statistically significant positive effects; however, this was not confirmed by the WWC. The average effect size for math achievement across study findings was not large enough to be considered substantively important. So, in this study, *CMP* had an indeterminate effect on math achievement, according to WWC criteria.

The Riordan & Noyce (2001) study examined total scores on the Massachusetts Comprehensive Assessment System (MCAS) and reported a statistically significant positive effect.

The Schneider (2000) study examined passing rates and students' scores on the Texas Learning Index using the Texas Assessment of Academic Skills (TAAS) and found no statistically significant effects. In addition, the average effect size across all outcomes for this study was neither statistically significant nor substantively important (that is, at least 0.25). So, in this study, *CMP* had an indeterminate effect on math achievement, according to WWC criteria.

Rating of effectiveness

The WWC rates the effects of an intervention in a given outcome domain as: positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. The rating of effectiveness takes into account four factors: the quality of the research design, the statistical significance of the findings (as calculated by the WWC[5]), the size of the difference between participants in the intervention and the comparison conditions, and the consistency in findings across studies (see the WWC Intervention Rating Scheme).

The WWC found the *Connected Mathematics Project* to have mixed effects for math achievement

Improvement index

The WWC computes an improvement index for each individual finding. In addition, within each outcome domain, the WWC computes an average improvement index for each study and an average improvement index across studies (see Technical Details of WWC-Conducted Computations). The improvement index represents the difference between the percentile rank of the average student in the intervention condition versus

4. The WWC reviewed findings for students in grade 6 only as baseline data (that is, math achievement before exposure to the program took place) was not taken into account in this study.
5. The level of statistical significance was reported by the study authors, or where necessary, calculated by the WWC to correct for clustering within classrooms or schools and for multiple comparisons. For an explanation, see the WWC Tutorial on Mismatch. See Technical Details of WWC-Conducted Computations for the formulas the WWC used to calculate the statistical significance. In the case of *CMP,* corrections for clustering and multiple comparisons were needed.

The WWC found the *Connected Mathematics Project* to have mixed effects for math achievement *(continued)*

the percentile rank of the average student in the comparison condition. Unlike the rating of effectiveness, the improvement index is entirely based on the size of the effect, regardless of the statistical significance of the effect, the study design, or the analysis. The improvement index can take on values between –50 and +50, with positive numbers denoting favorable results. The average improvement index for math achievement is –2 percentile points across the three studies, with a range of –12 to +11 percentile points across findings in two of the three studies. One additional study that showed a statistically significant positive effect is not included in the average and range because a student-level improvement index could not be computed.

Summary

The WWC reviewed 22 studies on the *Connected Mathematics Project.* Three of these studies met WWC evidence standards with reservations; the remaining studies did not meet WWC evidence screens. Based on these three studies, the WWC found the program to have mixed effects on math achievement. The evidence presented in this report may change as new research emerges.

References

Met WWC evidence standards with reservations

Ridgway, J. E., Zawojewski, J. S., Hoover, M. N., & Lambdin, D. V. (2002). Student attainment in the Connected Mathematics curriculum. In S. L. Senk & D. R. Thompson (Eds.), *Standards-based school mathematics curricula: What are they? What do students learn?* (pp. 193–224). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Additional source:

Hoover, M., Zawojewski, J. S., & Ridgway, J. E. (1997, April). *Effects of the Connected Mathematics Project on student attainment.* Paper presented at the meeting of the American Educational Research Association, Chicago, IL.

Riordan, J. E., & Noyce, P. E. (2001). The impact of two standards-based mathematics curricula on student achievement in Massachusetts. *Journal for Research in Mathematics Education, 32*(4), 368–398.

Schneider, C. L. (2000). Connected Mathematics and the Texas Assessment of Academic Skills. *Dissertation Abstracts International, 62*(02), 503A. (UMI No. 3004373)

Did not meet WWC evidence screens

Adams, L. M., Tung, K. K., Warfield, V. M., Knaub, K., Yong, D., & Mudavanhu, B. (2002). *Middle school mathematics comparisons for Singapore Mathematics, Connected Mathematics Program, and Mathematics in Context (including comparisons with the NCTM Principles and Standards 2000).* Retrieved from the University of Washington Department of Applied Mathematics Web site: http://www.amath.washington.edu/~adams/full.ps[6]

Bay, J. M., Beem, J. K., Reys, R. E., Papick, I., & Barnes, D. E. (1999). Student reactions to standards-based mathematics curricula: The interplay between curriculum, teachers, and students. *School Science and Mathematics, 99*(4), 182–188.[7]

Ben-Chaim, D., Fey, J. T., Fitzgerald, W. M., Benedetto, C., & Miller, J. (1997). *Development of proportional reasoning in a problem-based middle school curriculum.* College Park: University of Maryland, Department of Mathematics. (ERIC Document Reproduction Service No. ED412091)[8]

Ben-Chaim, D., Fey, J. T., Fitzgerald, W. M., Benedetto, C., & Miller, J. (1997, April). *A study of proportional reasoning among seventh and eighth grade students.* Paper presented

6. Outcome measures are not relevant to this review.
7. Does not use a strong causal design: this is a qualitative study.
8. Lack of evidence for baseline equivalence: the study, which used a quasi-experimental design, did not establish that the comparison group was equivalent to the intervention group at baseline.

References *(continued)*

at the meeting of the American Educational Research Association, Chicago, IL.[8]

Ben-Chaim, D., Fey, J. T., Fitzgerald, W. M., Benedetto, C., & Miller, J. (1998). Proportional reasoning among 7th grade students with different curricular experiences. *Educational Studies in Mathematics, 36*(3), 247–273.[8]

Cain, J. S. (2002). An evaluation of the Connected Mathematics Project. *Journal of Educational Research, 32*(4), 224–233.[8]

Clarkson, L. M. C. (2001). The effects of the Connected Mathematics Project on middle school mathematics achievement. *Dissertation Abstracts International, 61*(12), 4709A. (UMI No. 9997642)[9]

Griffith, L., Evans, A., & Trowell, J. (2000). *Arkansas grade 8 benchmark exam: How do Connected Mathematics schools compare to state data?* Little Rock: Arkansas State Department of Education.[8]

Krebs, A. S. (1999). Students' algebraic understanding: A study of middle grades students' ability to symbolically generalize functions. *Dissertation Abstracts International, 60*(06), 1949A. (UMI No. 9936570)[7]

Krebs, A. S. (2003). Middle grades students' algebraic understanding in a reform curriculum. *School Science and Mathematics, 103*(5), 233–245.[7]

Lapan, R. T., Reys, B. J., Barnes, D. E., & Reys, R. E. (1998, April). *Standards-based middle grade mathematics curricula: Impact on student achievement.* Paper presented at the meeting of the American Educational Research Association, San Diego, CA.[8]

Lapan, R., Reys, B., Reys, R., & Holliday, G. (2001). *Assessing the performance of middle grade students using standards-based mathematics instructional materials.* (Available from the University of Missouri, 121 Townsend Hall, Columbia, MO 65211)[9]

Lubienski, S. T. (2000). A clash of social class cultures? Students' experiences in a discussion-intensive seventh-grade mathematics classroom. *Elementary School Journal, 100*(4), 377–403.[7]

Lubienski, S. T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education, 31*(4), 455–482.[7]

O'Neal, S. W., & Robinson-Singer, C. (2003). *The Arkansas statewide systemic initiative pilot of the Connected Mathematics Project: An evaluation report.* Albuquerque, NM: Accountability & Development Associates, Inc.[8]

Reys, R., Reys, B., Lapan, R., Holliday, G., & Wasman, D. (2003). Assessing the impact of standards-based middle grades mathematics curriculum materials on student achievement. *Journal for Research in Mathematics Education, 34*(1), 74–95.[9]

Additional source:

Reys, R., Reys, B., Lapan, R., Holliday, G., & Wasman, D. (2004). Assessing the impact of standards-based middle grades mathematics curriculum materials on student achievement: Corrections. *Journal for Research in Mathematics Education, 35*(2), 152.

Rickard, A. (1995). Teaching with problem-oriented curricula: A case study of middle-school mathematics instruction. *The Journal of Experimental Education, 64*(1), 5.[7]

Wasman, D. G. (2000). An investigation of algebraic reasoning of seventh- and eighth-grade students who have studied from the Connected Mathematics Project curriculum. *Dissertation Abstracts International, 61*(09), 3498A. (UMI No. 9988711)[8]

Winking, D. (1998). *The Minneapolis Connected Mathematics Project: Year two evaluation.* Retrieved from the Minneapolis Public Schools, Teacher and Instructional Services Web site: http://tis.mpls.k12.mn.us/sites/5df1b159-7ce3-4aa3-8e71-8e60a7b98e6c/uploads/connected_mathematics_2.pdf[8]

9. Confound: there was only one unit of assignment in each study condition, so the analysis could not separate the effects of the intervention from the effects of the unit of assignment.

Additional sources:

Winking, D. (2000). *Minneapolis data: Excerpts from the year two evaluation report.* (Available from the Connected Mathematics Project, Michigan State University, A715 Wells Hall, East Lansing, MI 48824)

Winking, D. (2000). *Minneapolis data: Excerpts from the year one evaluation report.* (Available from the Connected Mathematics Project, Michigan State University, A715 Wells Hall, East Lansing, MI 48824)[8]

Zawojewski, J. S., Robinson, M., & Hoover, M. (1999). Reflections on developing formal mathematics and the Connected Mathematics Project. *Mathematics Teaching in the Middle School, 4*(5), 324–330.[7]

For more information about specific studies and WWC calculations, please see the [WWC *Connected Mathematics Project* Technical Appendices].